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Hyla stauffererorum, a New Species of Treefrog in the *Hyla larinopygion* Group from the Cloud Forests of Ecuador

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ABSTRACT A new species in the *Hyla larinopygion* group is described from cloud forests in the Cordillera de Guacamayos and Volcán Sumaco east of the Cordillera Oriental of the Andes in Ecuador. The new species is most similar to *Hyla caucana* from Colombia in having bold, yellow bars on the flanks and on the ventral and hidden surfaces of the limbs, but differs by having dark, instead of pale discs. The tadpoles have large ventral oral discs with 7–8/8–9 tooth rows.

Key words: Anura, Hylidae, *Hyla stauffererorum* new species, Ecuador.

RESUMEN Una especie nueva en el grupo de *Hyla larinopygion* se describe de los bosques nublados en la Cordillera de Guacamayos y del Volcán Sumaco al este de la Cordillera Oriental de los Andes en el Ecuador. La especie nueva es más similar a *Hyla caucana* de Colombia, a la que se parece por tener barras distintivas amarillas en los flancos y en las superficies ventrales y escondidas de los miembros pero se diferencia por tener discos oscuros en lugar de discos pálidos en los dedos. Los renacuajos tienen discos orales grandes y ventrales, y 7–8/8–9 filas de dientes.

Palabras claves: Anura, Hylidae, *Hyla stauffererorum* especie nueva, Ecuador.

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Biological exploration of the cloud forests on the slopes of the Andes in Colombia, Ecuador, and Peru continues to reveal the presence of many previously unknown species of frogs, especially members of the family Centrolenidae (e.g., Duellman and Schulte, 1993), and of the genera *Colostethus* (e.g., Duellman and Simmons, 1988), *Eleutherodactylus* (e.g., Lynch and Duellman, 1980), and *Hyla* (e.g., Duellman and Hillis, 1990). Our paucity of knowledge of even large, conspicuous frogs dwelling in these cool, moist forests is evidenced by the fact that the first adult specimen of the eight large species of treefrogs in the *Hyla larinopygion* group was discovered in 1971 (Duellman, 1973). Since then, progressively more species of these large frogs have been found in Colombia and Ecuador, where they seem to be restricted to cool montane forests at elevations exceeding 1900 m.

Duellman and Hillis (1990) reviewed the *Hyla larinopygion* group and described three new species from Ecuador. Twelve days after the publication of that paper (8 March 1990), the junior author, accompanied by Diego Tirira, Sebastián Valdivieso, and John J. Wiens, collected the first specimens of another new species in the group. This brings to nine the number of species known in the group, which ranges from the central part of the Cordillera Central in Colombia to the Pacific and Andean slopes of the Andes in Ecuador.

MATERIALS AND METHODS

Collections are abbreviated as follows: KU = Museum of Natural History, The University of Kansas; QCAZ = Museo de Zoología, Pontificia Universidad Católica del Ecuador. Measurements were taken to the nearest 0.1 mm using needle-nosed calipers in the manner described by Duellman (1970). The formula for toe webbing is based on Savage and Heyer (1967) as modified by Myers and Duellman (1982). Tadpoles were staged according to Gosner (1960). Terminology of larval features follows Altig and Johnston (1989). Format for the tadpole description follows McDiarmid and Altig (1990); distances involving eyes and nares were measured from the middle of those structures. The advertisement call was recorded on a Marantz PMD420 cassette tape recorder using a Sennheiser directional microphone; the call was analyzed on a Macintosh Computer using Canary 1.1 Software (Bioacoustics Research Laboratory, Cornell Laboratory of Ornithology) and digitized at a sampling rate of 22 kHz.

Hyla staufferorum new species

Holotype.—KU 217695, an adult male, from 27 km (by road) N of Jondachi, Cordillera de Guacamayos (00°33' S, 77°53' W, 2040 m), Provincia Napo, Ecuador, one of a series collected on 20 March 1990 by

Luis A. Coloma, Diego Tirira, Sebastián Valdivieso, and John J. Wiens.

Paratypes.—KU 217694, 217696, and QCAZ 3705–6, adult males collected with the holotype. QCAZ 3703, adult female from Lago Sumaco, Volcán Sumaco (00°31' S, 77°38' W, 2500 m) Provincia Napo, Ecuador, 29 July 1992 by Amy Barden.

Referred specimens.—KU 218315, QCAZ 2666, 3707 (all tadpoles) from the type locality; QCAZ 3701–02, subadult females, from Lago Sumaco, Volcán Sumaco, 2500 m, Provincia Napo, Ecuador, 29 July 1992, by Amy Barden and Andrew G. Gluesenkamp; QCAZ 3704, tadpole, from 31 km (by road) S of Baeza (ca. 00°30' S, 77°39' W, 2210 m), Provincia Napo, Ecuador, 10 August 1989, by Luis A. Coloma, Luis E. López, and Diego Tirira.

Diagnosis.—A member of the *Hyla larinopygion* group as defined by Duellman and Hillis (1990), differing from other members of that group having uniform, or nearly so, brown or black venters as follows: (1) from *H. lindae* by having cream bars on the limbs and by lacking pale discs on the digits; (2) from *H. sarampiona* by having cream bars, instead of red spots, on the hidden surfaces of the limbs; (3) from *H. ptychodactyla* by having cream bars on the hidden surfaces of the limbs and by lacking large, pale spots on the throat; and (4) from *H. caucana* by lacking pale discs on the digits and small, pale flecks on the throat. All other members of the group have boldly mottled black and cream or blue and cream venters (*H. larinopygion*, *pacha*, and *pantosticta*) or a gray venter with brown and cream spots (*H. psarolaima*). The only other hylid in eastern Ecuador with a uniformly dark brown throat and belly is *Nyctimantis rugiceps*, a casque-headed frog with a pale gray dorsum and large yellow spots on the flanks and posterior surfaces of the thighs (Duellman and Trueb, 1976).

Description.—n = 5 ♂♂, 1 ♀. Body robust; snout-vent length (SVL) in males 52.9–56.9 mm ($\bar{x}$ = 55.1), female 59.7; head about as wide as long, as wide as body; head width 32.4–34.6% ($\bar{x}$ = 33.5) SVL; head length 33.8–35.4 % ($\bar{x}$ = 34.6) SVL; snout rounded in dorsal view, truncate in profile; canthus rostralis rounded transversely; loreal region concave, lips rounded; internarial region slightly depressed; nostrils barely protuberant, directed anterolaterally at anterior terminus of canthus rostralis, at point slightly posterior to anterior margin of lower jaw; top of head flat; interorbital distance 104–110% ($\bar{x}$ = 106) width of eyelid; diameter of eye slightly greater than its distance from nostril; tympanum round, separated from eye by distance about 1.5 times diameter of tympanum; tympanic annulus distinct; supratympanic fold heavy, obscuring upper edge of tympanum, extending to point slightly posterior to tympanum.

Forearm moderately robust; axillary membrane and ulnar tubercles absent; fingers long, slender; relative length of fingers 1 < 2 < 4 < 3; discs round; width of disc on third finger about equal to length of tympanum;

lateral fringes absent; webbing basal between Fingers II and III and between Fingers III and IV; subarticular tubercles moderately large, round; supernumerary tubercles large, round; palmar tubercle small, oblong; thenar tubercle large, elliptical; prepollex large, protruding in males, smaller in female; nuptial excrescences present on inner side of thumb in breeding males (Fig. 1). Hind limb moderately short, robust; tibia length 48.6–52.3% ($\bar{x}$ = 50.3) SVL; foot length 43.1–48.6% ($\bar{x}$ = 46.4) SVL; heel tubercle small, triangular; inner tarsal fold absent; inner metatarsal tubercle low, elongate; outer metatarsal tubercle absent; relative length of toes 1 < 2 < 5 < 3 < 4; toes about two-fifths webbed; webbing formula I (2—2)—2½ II (2—2)—3 III 2—3 IV 3—(2—2) V; subarticular tubercles round; supernumerary tubercles absent (Fig. 1).

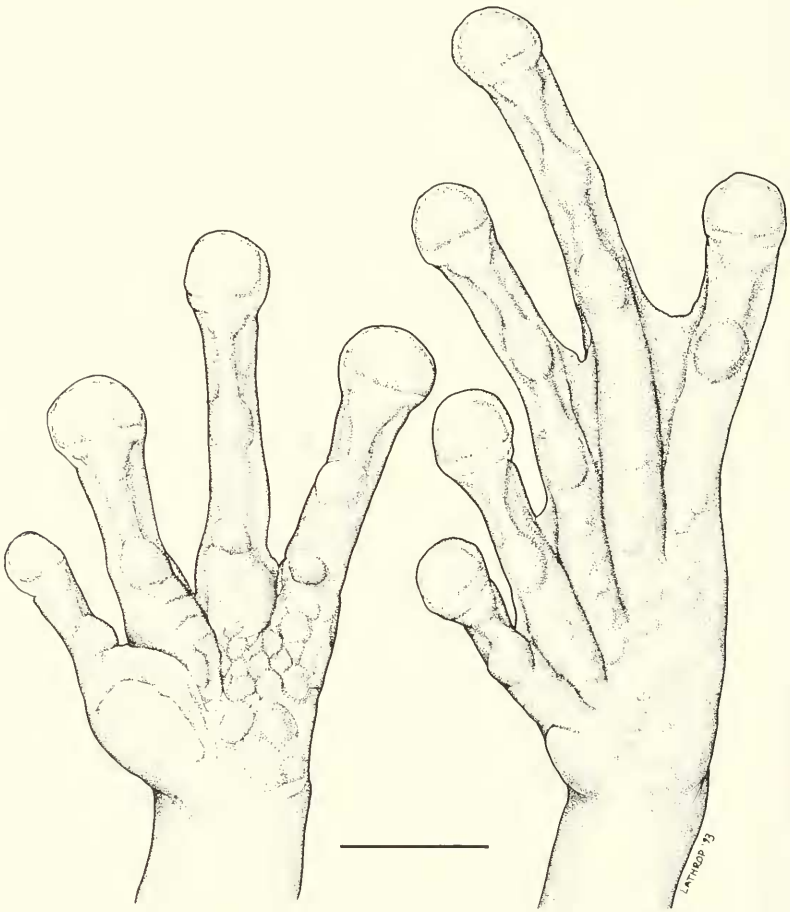

Fig. 1. Hand and foot of *Hyla staufferorum*. KU 217695. Line = 5 mm.

Skin on dorsum and flanks finely shagreen, on belly and proximal posteroventral surfaces of thighs granular; other ventral surfaces smooth. Cloacal opening directed posteroventrally at midlevel of thighs; cloacal sheath short; cloacal tubercles and folds absent. Vocal sac large, single, median, subgular; vocal slits short, ovoid, in line between midlateral base of tongue and angle of jaws; tongue about twice as long as wide, shallowly indented posteriorly, barely free behind; vomerine odontophores long, transverse, abutting medially, behind level of large, ovoid choanae, bearing total of 21–24 ($\bar{x}$ = 22.2) teeth in males, 25 in female.

Color in preservative: Dorsum and flanks dark chocolate-brown with one or more irregularly shaped, vertical, cream bars on flanks; hidden surfaces of limbs black with broad vertical cream bars; venter dark brown (black in female) with broad, transverse cream bars on limbs; hands and feet, including discs, uniform dark brown, except for cream mark on thumb. Number of cream bars variable—inner surfaces of forearms 1–2 ($\bar{x}$ = 1.7) with proximal bar continuous with distal bar on upper arm in all but one specimen; upper arm 1, continuous with axillary spot in all but one specimen; axilla 1; flanks 1–3 ($\bar{x}$ = 2) with posterior bar continuous with bar in groin in one specimen; groin 1; ventral surfaces of thighs 3–4 ($\bar{x}$ = 3.3); ventral surfaces of shanks 3–4 ($\bar{x}$ = 3.2); inner surfaces of tarsi 2–4 ($\bar{x}$ = 2.8).

Color in life: Adult males—Dorsum uniform dark brown; axilla, flanks, groin, and hidden surfaces of limbs with white bars (Fig. 2); venter grayish brown; iris gray (L. A. Coloma field notes, 20 March 1990). Subadult females—Dorsum brown with black and white bars on flanks, posterior surfaces of forelimbs, and anterior and posterior surfaces of hind limbs; venter pale with gray mottling and black spots (A. G. Gluesenkamp field notes, 29 July 1992). Color photographs of QCAZ 3705 show that the intensity of the dorsal color changes from dark chocolate-brown to a paler grayish brown. The distended vocal sac is pale gray.

Measurements of holotype (in mm): SVL 56.9, tibia length 28.6, foot length 27.1, head length 19.6, head width 19.7, interorbital distance 6.6, upper eyelid width 6.3, internarial distance 4.9, eye diameter 6.6, eye-nostril distance 5.7, tympanum diameter 3.7.

Tadpoles.—Suctorial tadpoles of the *Hyla larinopygion* group collected at the type locality presumably belong to this species. All 18 tadpoles are in Stage 25, but range in body length 10.5–28.0 mm and total length 40.5–74.6 mm. Measurements (in mm) of a typical large individual (KU 218315) are: total length 71.0; body length 25.0; basal caudal musculature height 8.3; basal caudal musculature width 7.0; maximum dorsal fin height (at point 26.8 mm from posterior edge of body at midheight of caudal musculature) 5.1; maximum ventral fin height (at point 28.4 mm from posterior edge of body at midheight of caudal musculature) 4.3; greatest body height

Fig. 2. *Hyla stauffferorum:* Top left and right—adult male, QCAZ 3705. *Hyla larinopygion:* Lower left—adult male, QCAZ 4170; lower right—adult male, QCAZ 4171. Photos by L. A. Coloma.

(level of spiracle) 11.2; greatest body width (just posterior to orbits) 13.0; eye diameter 1.9; pupil diameter 0.8; interorbital distance 6.3; narial diameter 0.4; internarial distance 5.0; snout-naris 5.1; snout-eye 8.6; snout-spiracle 13.8; naris-eye 3.5; width of oral disc 9.2.

Body elongately ovoid, slightly wider than high; snout broadly rounded in dorsal view, abruptly sloping from nares to snout in profile; eyes dorsolateral; nares lacking ornamentation, directed dorsolaterally; spiracle sinistral; spiracular tube short, its opening directed posteriorly at midheight of body; cloacal tube short, dextral; neuromasts clearly visible; caudal musculature extending nearly to tip of pointed tail; dorsal fin arising gradually from base of caudal musculature.

Oral disc ventral with lateral folds; marginal papillae unpigmented, short, blunt, in single row; papillary gap absent; about 30 papillae per mm on median part of upper labium; few larger submarginal papillae in lateral fold; jaw sheaths completely keratinized; upper sheath narrow, shallow arch with straight median distal edge bearing small, blunt serrations; lower sheath broadly V-shaped with small, blunt serrations; labial tooth row formula (LTRF) 8(2)/9(1); teeth on distinctly elevated ridges; in median part of A3, 35 teeth per mm (Fig. 3).

Fig. 3. Tadpole of *Hyla staufferorum*. KU 218315. Upper figure: total length = 71.0 mm; lower figure: total width = 9.2 mm.

In preservative, dorsum and sides of body brown with small, scattered dark brown flecks; belly gray; labia pale grayish white; caudal musculature tan with small brown flecks and bold dark brown dorsolateral stripe on anterior three fifths of tail; fins translucent with small dark brown flecks. In life, body tan with brown blotches; dorsal musculature between dark brown dorsolateral stripes golden yellow.

Tadpoles of all sizes in Stage 25 have the same color pattern and body proportions, but the LTRF varies from 6(2)/7(1) in the smaller individuals to 7(2 or 3)/8(1) or 9(1) in larger tadpoles. One individual having a total length of 55.5 mm has a LTRF of 8(3)/9(1).

Advertisement call.—The advertisement call consists of a series of short whistle-like notes. A recording of QCAZ 3706 made at 18°C reveals that calling bouts consist of 4–17 notes ($\bar{x}$ = 9.7); each bout has a duration of 3–13 sec ($\bar{x}$ = 7.5). Notes are about 75 msec in duration, during which there is a slight increase in amplitude. The dominant frequency is at 1.63 kHz; distinct harmonics exist at 3.37, 5.06, 6.69, 8.43, and 10.06 kHz.

Distribution and ecology.—This species is known from two areas—Volcán Sumaco lying east of the main Andean Cordillera and the Cordillera de Guacamayos (Huacamayos on some recent maps) an eastward spur of the Andean cordillera extending to Volcán Sumaco. Both localities are in cloud forest at elevations of 2500 and 2040 m, respectively. This vegetation type was designated the Very Humid Low Montane Forest Life Zone characterized by annual mean precipitation of 2000–4000 mm and annual mean temperatures of 12–18°C by Cañadas-Cruz (1983). Both localities

are in the Río Napo Drainage. Lago Sumaco is drained by a small stream that flows into the Río Pucuno, whereas the southern slope of the Cordillera de Guacamayos is drained by the Río Jondachi, a tributary of the Río Misahuallí, which, together with the Río Pucuno, flows into the Río Napo.

At the type locality, which is on the road between Baeza and Tena just to the south of the crest of the Cordillera de Guacamayos, males were calling at night from branches of bushes along a small stream. Tadpoles were in pools in the stream. At Lago Sumaco, an adult female and two subadult females were in bromeliads on horizontal branches of trees 3–5 m above the ground by day.

Etymology.—We take great pleasure in naming this species for John H. and Ruth Stauffer of Topeka, Kansas. They have provided generous financial support to the Neotropical Biological Diversity Program of the Museum of Natural History at The University of Kansas. This program partially supported the field work in Ecuador that resulted in the discovery of the new species of *Hyla* named herein.

DISCUSSION

Subsequent to the review of the *Hyla larinopygion* group by Duellman and Hillis (1990), Ardila-Robayo et al. (1993) named *Hyla caucana* from the southern part of the Cordillera Central in Colombia; this species was referred to as "Species A" by Duellman and Hillis (1990). The tadpole of *H. caucana* is structurally like that of *H. stauffferorum*, but it differs in having large blotches on the caudal musculature and dorsal fin, by having as many as 9/12 rows of labial teeth, and by attaining a total length of 107.8 mm in Stage 25. Structurally, the tadpole of *H. lindae* also resembles that of *H. stauffferorum*, but it differs by having two rows of marginal papillae, a LTRF of 6/8, and different coloration (Duellman and Altig, 1978).

Hyla larinopygion is known from several localities in the Cordillera Occidental and Cordillera Central in Colombia (Ardila-Robayo et al., 1993). Five adult males (QCAZ 4167–71) and eight tadpoles (QCAZ 4172) from 22 km E of Maldonado, 2560 m, Provincia Carchi, represent a southern range extension and the first record for the species from Ecuador. The adult males have snout-vent lengths of 57.5–60.7 mm ($\bar{x}$ = 58.8 mm); these measurements fall within the range of variation of 10 males (53.5–61.9 mm) from the Municipio Sonsón, Departamento Antioquia, Colombia (Ardila-Robayo et al., 1993). In contrast to the uniform brown dorsum of the holotype, the dorsum in four of the Ecuadorian specimens is brown with large darker brown blotches narrowly outlined by yellow (Fig. 2). This dorsal pattern is not uncommon in *Hyla larinopygion* from the Cordillera Occidental in Colombia (J. D. Lynch, pers. comm.).

As noted by Duellman and Hillis (1990), most of the morphological

characters among species in the *Hyla larinopygion* group are autapomorphic; thus, determination of interspecific relationships on the basis of morphological characters is difficult. The continued discovery of species in this group having restricted distributions on the Pacific and Amazonian slopes of the Andes and in the Cordillera Central in Colombia suggests that the vicariance of isolated populations may have resulted through alternate compression and expansion of cloud forests during the Quaternary, as hypothesized by Duellman (1982).

KEY TO ECUADORIAN SPECIES OF THE *HYLA LARINOPYGION* GROUP

1. Venter uniformly or predominantly black or dark brown 2

   Venter mottled black and white or blue, or brownish gray with brown spots and cream flecks 3

2. Digital discs pale ..... *H. staufferorum*

   Digital discs dark 4

3. Throat uniformly dark ..... *H. lindae*

   Throat with large pale spots ..... *H. ptychodactyla*

4. Venter brownish gray with dark brown spots and cream flecks; dorsum brown with small dark brown and cream flecks ..... *H. psarolaima*

   Venter mottled dark brown or black and white or blue; dorsum uniform brown or with orange (cream in preservative) spots or flecks 5

5. Dorsum brown, with or without darker brown blotches; flanks and hidden surfaces of thighs with bold black and blue (cream in preservative) vertical bars ..... *H. larinopygion*

   Dorsum brown or black with orange (cream in preservative) spots or flecks; flanks spotted or barred 6

6. Dorsum brown with small orange flecks; throat and belly dark brown with bold cream mottling; hidden surfaces of limbs black with narrow, vertical, cream bars; discs on digits cream and black ..... *H. pacha*

   Dorsum and throat black with orange spots; belly black with white mottling; hidden surfaces of limbs black with orange spots; discs on digits yellow ..... *H. pantosticta*

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